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Disposition of aquifer system in parts of Gadilam, Paravanar, Lower Vellar Watershed, Cuddalore district, Tamil Nadu

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ABSTRACT

The distribution and quantification of ground water in the aquifer system is prime importance for efficient management of groundwater. Aquifer mapping studies bring out the vertical and lateral extent of the aquifer system which in turn paves way for efficient management of the aquifer system. Such studies were carried out in the Part of Gadilam – Paravanar watershed of Cuddalore district to bring out the aquifer disposition. The study area (Part of Gadilam - Paravanar watershed) lies between North latitudes 11° 25' 23' and 11° 45' 36" and East longitudes 79° 28' 23" and 79° 47' 15"and falls in survey of India Toposheet No.58 M/6, 58 M/10 & M/14 AND 58 m/11. The total extent of the study area is 990 Sq. Km. The area experiences tropical humid climate with an average annual rainfall of 1400 mm which is received during both southwest and northeast monsoons. The area is drained by Paravanar and Uppanar rivers. Geologically the area has three distinct formations: Recent Alluvium, Cuddalore sandstone of Mio-Pliocene age and Sandstones of Eocene age.

The data obtained from the exploratory drilling and recent field surveys were used to bring out the lateral and vertical disposition of the aquifer system. The study reveals the existence of multilayered aquifer system with four aquifer units (Aquifer I - Phreatic aquifer; Aquifer II – Leaky/confined aquifer; Aquifer-III & IV - Two Confined aquifers) upto the depth of 300m bgl. The determined disposition of the aquifer system is used for effective management of ground water aquifers in the Gadilam and Paravanar watershed.

Keywords: Gadilam, paravanar, multilayered aquifer system, cuddalore sandstone 2d & 3d aquifer disposition, paravanar and india.

1. Introduction

Aquifer mapping studies were carried out in the Part of Gadilam – Paravanar watershed of Cuddalore district to bring out the aquifer disposition. The study area forms part of Gadilam-Paravanar & Lower Vellar watersheds (which is of Kadampuliyur, Kurunjipadi, Sengalodai, Perumaleri and Pachiyakuppam micro watersheds) has been identified for the aquifer mapping studies (Figure.1). The study area falls in Pondicherry-Cuddalore sub basin of Cauvery Basin. It is bounded by Gadilam River in the North and Vellar River in the south, Kallar and Chinnar watersheds in the west and Bay of Bengal in the east. The study area is located in Cuddalore district which is one of the coastal districts of the Tamil Nadu state. It lies between North latitudes 11° 25' 23' and 11° 45' 36" and East longitudes 79° 28' 23" and 79° 47' 15"and falls in survey of India Toposheet No.58 M/6, 58 M/10 & M/14 AND 58 m/11. The total aerial extent of the study area is 990 Sq. Km.

1.1 Climate & Rainfall

The study area experiences tropical humid climate with an average annual rainfall of 1400 mm which is received during both southwest and northeast monsoons. The climate of this region is characterized by a long and severe summer, moderate monsoon and mild winter. Summer months are from March to May, followed by the south-west monsoon (June to August). The high precipitation monsoon months are September to December, when the area is influenced by the Northeast monsoon followed by winter months. The temperature is warm during the summer months with a maximum temperature of 41^0 C in May. The lowest temperatures range between 18^0 and 21^0 C in winter months.

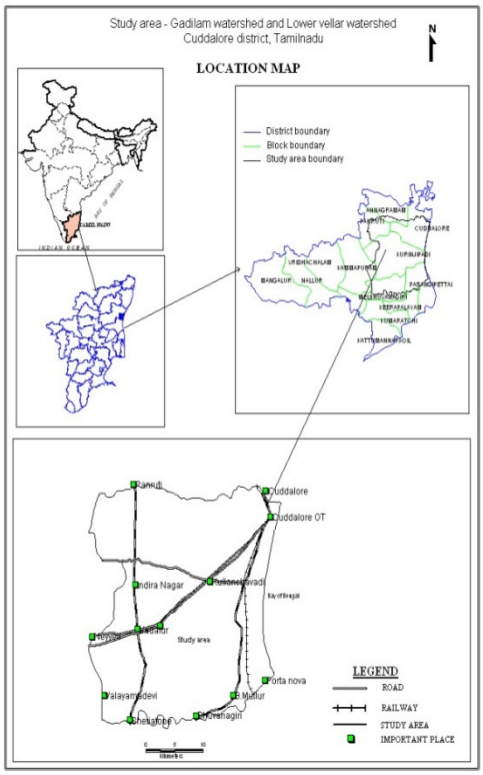

Figure 1: Location of study area

1.2 Soil

The major soil types observed in the study area are Red soil, alluvial soil, Sand loam and Sandy soil. Majority of the study area is covered by red soil mainly over the laterite cape and the alluvial soil is seen over the southern part of the study area, whereas the sandy soil is spread over a large extant mainly in the discharge area of Perumal Eri and some patch of sandy loam soil is seen over the eastern part. In general the soil is rich in humus and fertile and is good for agricultural activity.

1.3 Drainage

The study area is drained by Gadilam, Vellar, Paravanar and Uppanar rivers (figure 2). Small nalas viz. Sengal Odai and Kaniyakoil Odai also drains the area. The Perumal Eri is the major water body (15sq.km), receives water from Paravanar and many small streams. During monsoon the Perumal eri fills up and drains to the Uppanar River. The small nallas oriented along the northwest-southeast direction forms the catchment of Perumal Eri.

1.4 Geomorphology

Geomorphologically, the area is subdivided into four clauses, namely the Tertiary upland, alluvial plain, coastal plain (Figure-3). Some of the other geomorphological features present in the area are Beach ridge, Burried channel, brackish water creeks, salt flat, buried pediplain, oxbow alluvium and swale etc. Tertiary upland covers majority of the study area and constitutes laterite formation. Alluvial plain is located as a thick strip form southwest to the central part of the study area. Rest of the area is covered by the coastal plain mainly along the southeastern and eastern part.

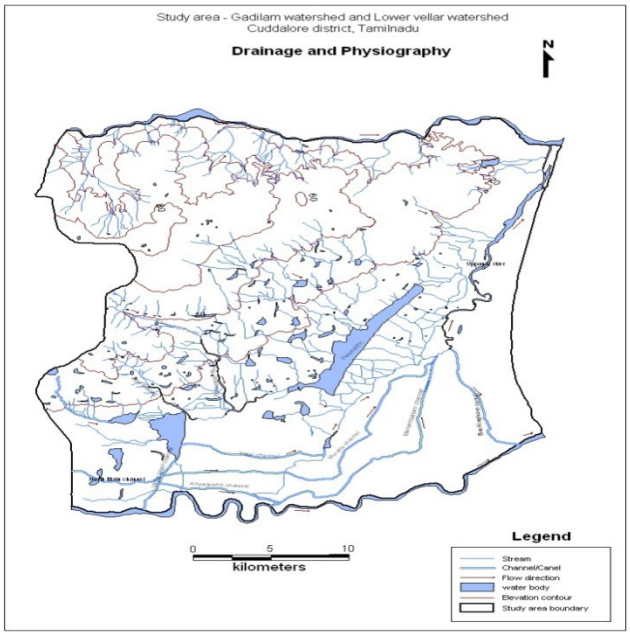

Figure 2: Drainage and Physiography

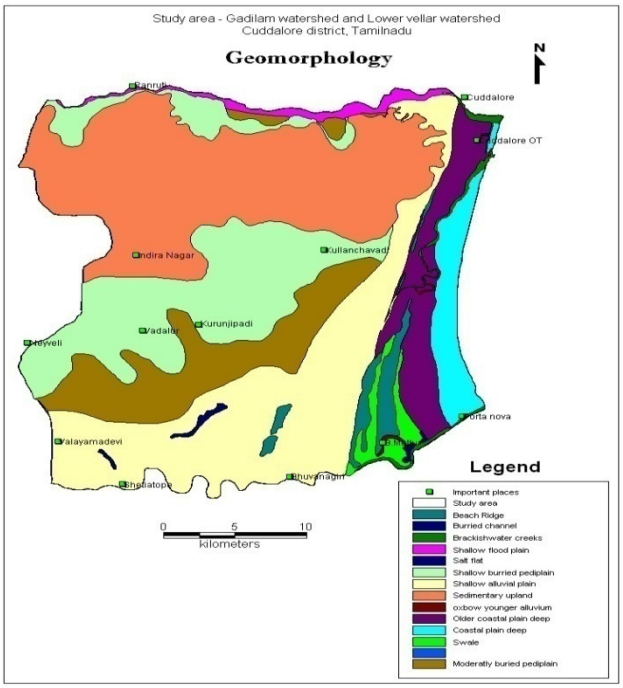

Figure 3: Geomorphology

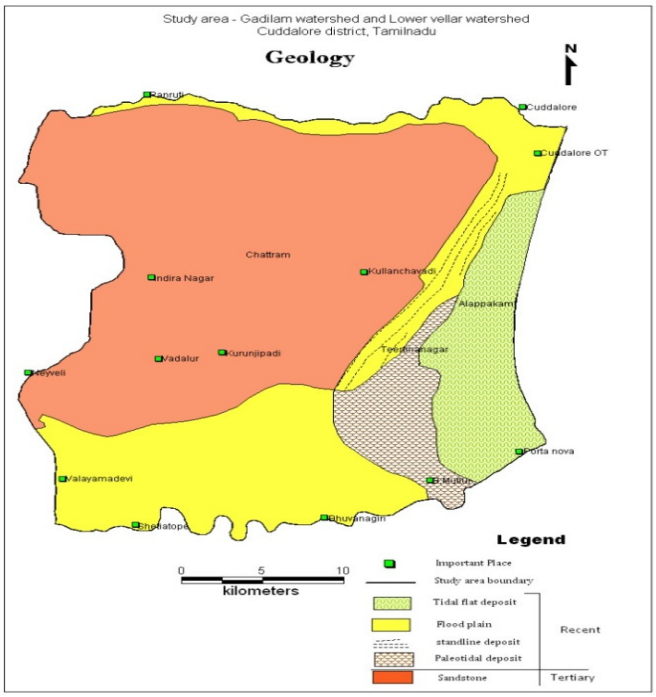

Figure 4: Geology

1.5 Geology

Geologically the area has three distinct formations: Recent Alluvium, Cuddalore sandstone of Mio-Pliocene age and Sandstones of Eocene age (Subramanian V, 1969). The Alluvium formation consists of soils, sands, laterites and recent alluvium and is under lined by the Cuddalore sandstone of Mio-pliocene age. The Cuddalore sandstone comprises of ferruginous sandstone, pebble bearing sandstone, ferruginous sandstone, grits and clay beds (Balasundar N.K 1968, Subramanian, K.S (2001). They are whitish, pinkish, reddish in colour. The sands and sandstones of cuddalore formation of Mio-pliocene age range in size from fine to very coarse grained and are sub-angular to sub-round in shape. The sandstones of Eocene age underlies the cuddalore sandstone of Mio-Pliocene age. The Lignite deposits occur underlying the Cuddalore sandstone is of Eocene age. These formations have strike along the NNE-SSW and dips along SSW directions. The stratigraphic succession of the Project Area is given below;

Table 1: Stratigraphic succession

Era	Age	Formation	Lithology
Quaternary	Recent to sub recent	Alluvium and Laterite	Alluvium, Coastal Sands, sand, clays and Laterite
Unconformity			
Tertiary	Mio-Pliocene	Cuddalore Sandstone	**Sandstone**, clays (variegated), pebble beds
	Eocene	Sandstone	**Sandstone**, **lignite**, clay with pebble beds

(After Gnanasundar. D and Rameshkumar. N, Year 2013)

2. Materials and methods

The data obtained from the lithologs and geophysical logs from the exploratory bore holes drilled by Central Ground Water Board (CGWB) and the information collected based on the extensive field survey are used in the present study. Geological cross sections (2 Dimension & 3 Dimension) are being used to define the aquifer geometry. The study of aquifer geometry is important as it facilitates to quantify the ground water availability in the aquifer system which is prime importance for effective management of groundwater. In total 24 litholog and 15 electrical logs were analysed to bring out the aquifer disposition.

3. Results and discussion

Based on the Geological, Hydrogeological and Geophysical information (Figure-5) it is inferred that the area consist of the Alluvium of Recent age, Cuddalore sandstones of Mio-pliocene age and Sandstones of Eocene age. The Hydrogeological sections (2D & 3D aquifer disposition) (figure 6,7,8 & 9) were brought out so as to bring out the different aquifer units.

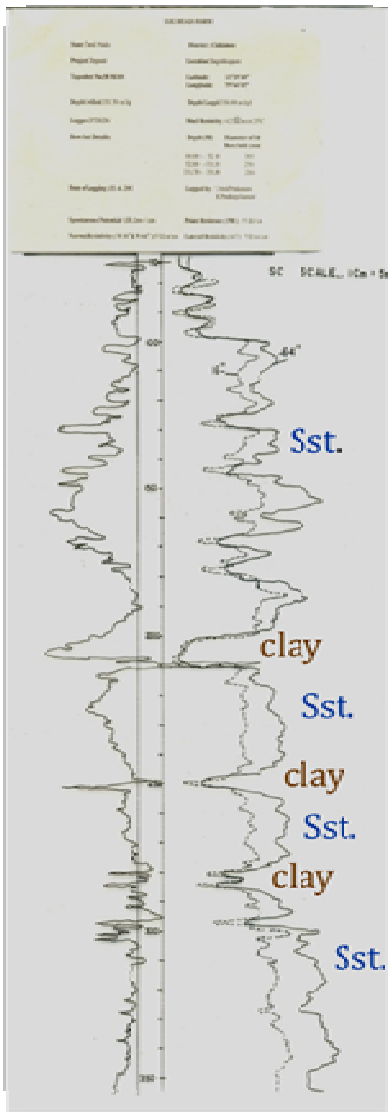

Figure 5: Electrical log

Based on the 2 Dimension and 3 Dimensional aquifer disposition, the vertical and lateral extension of the aquifer have been brought out in this study. The inferences derived from the aquifer mapping studies in the following paras.

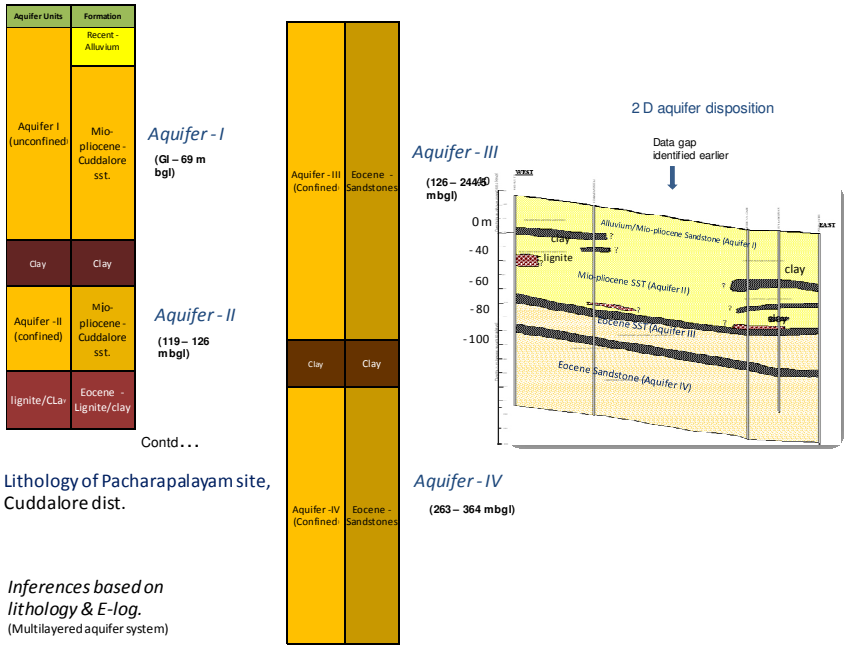

Figure 6: 2D disposition of aquifer system along West to East direction

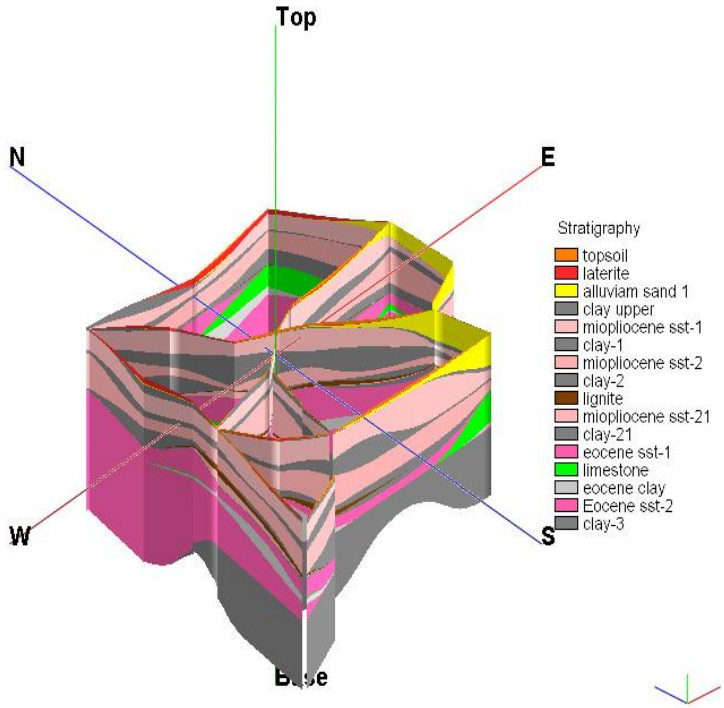

Figure 7: 3D disposition of the aquifer system

3.1. Alluvium Aquifer of recent age

The alluvium aquifer names as Aquifer-I, comprises of mainly of sand, clayey sand and laterites and are unconfined in nature. The thickness of the aquifer ranged between 5 and 30 m. They are Unconfined and the groundwater level ranged between 2 and 20 m bgl. The

groundwater quality of the alluvium aquifer is good and the Electrical Conductivity (EC) ranged between 300 and 1500 microsimens/cm. The groundwater development is mostly by Dug-cum-tubewells and shallow tubewells mainly for irrigation purpose.

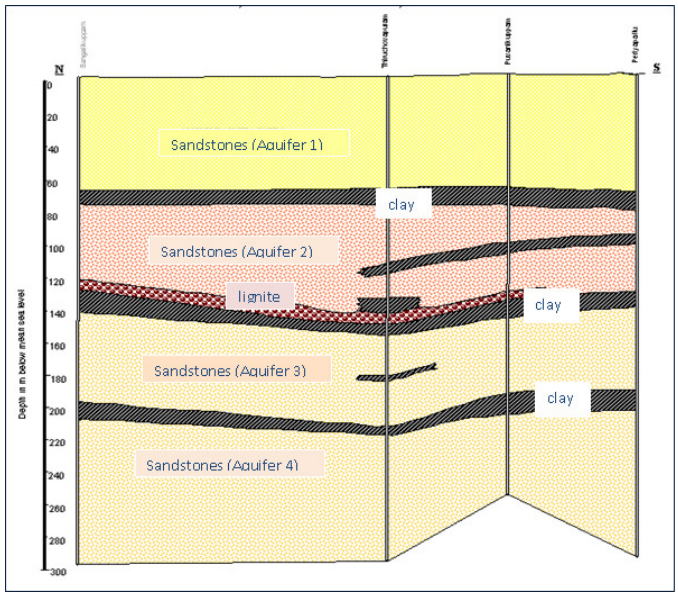

Figure 8: 2D disposition of the aquifer system along North to South direction

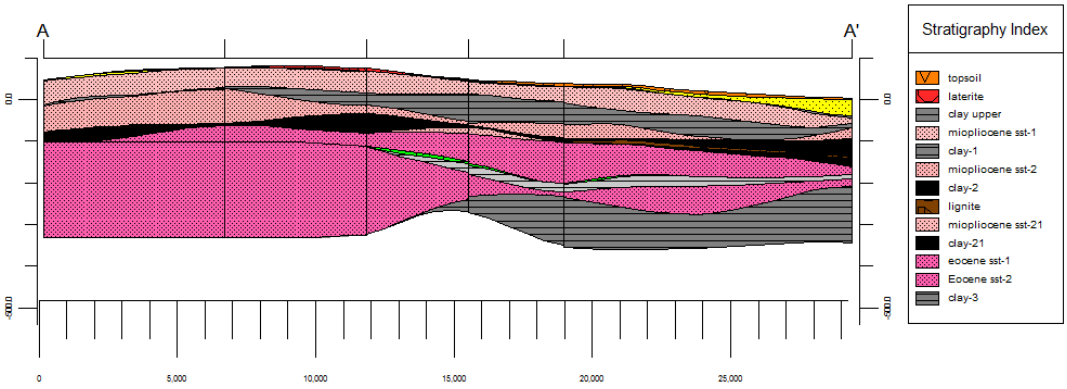

Figure 9: 2D disposition of aquifer system along NNW-SSE (Strike direction)

3.2 Cuddalore sandstones of Mio-Pliocene age

The Cuddalore sandstone comprises of argillaceous sandstone, pebble bearing sandstone, ferruginous sandstone, gravel, grits and clay beds. They are whitish, pinkish, reddish or mottled in colour and are chiefly argillaceous and ferrogeneous in nature. The cuddalore sandstones occur below the alluvium aquifer. At some places the cuddalore sandstones are exposed. The thickness of the cuddalore sandstone varies from 60 and 140 m. The sands are medium to coarse grained also pebbles occur at varying depths.

The Cuddalore sandstones are confined in nature and occur at the depth of 40 – 140 m overlying the lignite bed (Aquifer-II). Generally clay occurs over and below the lignite deposits. Hence, the Lignite deposits occur underlining the cuddalore sandstones acts as a marker horizon between the cuddalore stone aquifer and Eocene sandstone aquifer. The piezometric head of the aquifer (cuddalore sandstones) ranged between 20 and 50 m above

msl. The aquifer is developed by tubewells (20 to 100 m in depth) mainly for irrigation purposes. Rainfall recharge is the only source of aquifer replenishment. The recharge area exists in the western part. The yield of the tubewells range between 5 and 35 lps.

3.3 Sandstones of Eocene age

The sandstone aquifer occurs beneath the lignite occurs under confined conditions(Aquifer III & IV). A thin discontinuous (3 to 10 m thickness) clay layer occurs at 110 – 140 m bgl separates the aquifer as lower and upper confined aquifer. The aquifer material comprises of very fine to coarse sand with occasional clay intercalations. The aquifer is developed by deep tubewells for irrigation purposes. The piezometric head varies from 60-105 mbgl. It has also been observed during exploration about 2 to 3 decades back there was free flowing conditions in most of the wells drilled. Exploration by CGWB down to a depth of 400 m in the area has revealed that wells tapping part of lower and upper confined aquifers have a discharge of >10 to 45 lps (CGWB,2011).

4. Summary and conclusions

Aquifer mapping studies based on geological, hydrogeological and geophysical techniques carried out in the Parts Gadilam, Paravanar and Lower Vellar watershed has provided much required lithological, stratigraphic and hydrogeological information on the aquifers present beneath. The results of the aquifer mapping studies inferred that the sandstones are the principle aquifer and are highly potential. Four aquifer units were decipher within the sandstones down to the depth of 400 m bgl viz. aquifer-I (Phreatic), Aquifer-II (Leaky/confined), Aquifer-III (Confined) and Aquifer-IV (Confined). As the study area being the coastal aquifer and groundwater withdrawal from the aquifer II & III is quite extensive, the information on the thickness and the lateral extension of the aquifer units obtained from this study is currently used in planning and management of the groundwater aquifers effectively.

5. Acknowledgement:

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